EXHIBIT 1

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Watanabe

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(54) **GOLF BALL**

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(58) **Field of Search** 473/251–377

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(57) **ABSTRACT**

A multi-piece golf ball includes a rubbery elastic core, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer between the core and the cover. The intermediate layer is composed of a resin material which is harder than the cover. The elastic core has a hardness which gradually increases radially outward from the center to the surface thereof. The center and surface of the elastic core have a hardness difference of at least 18 JIS-C hardness units. This construction and combination of features improve the distance of the ball when struck with a driver, provide the ball with excellent spin characteristics and thus good controllability on approach shots, and gives the ball a good feel on impact, enabling the ball to meet the high expectations of skilled golfers.

27 Claims, 1 Drawing Sheet

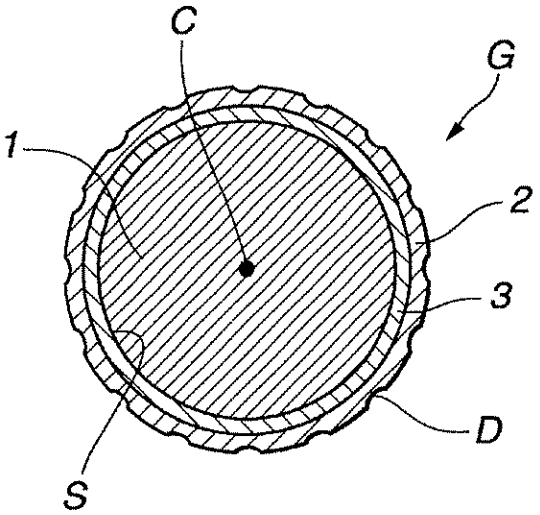
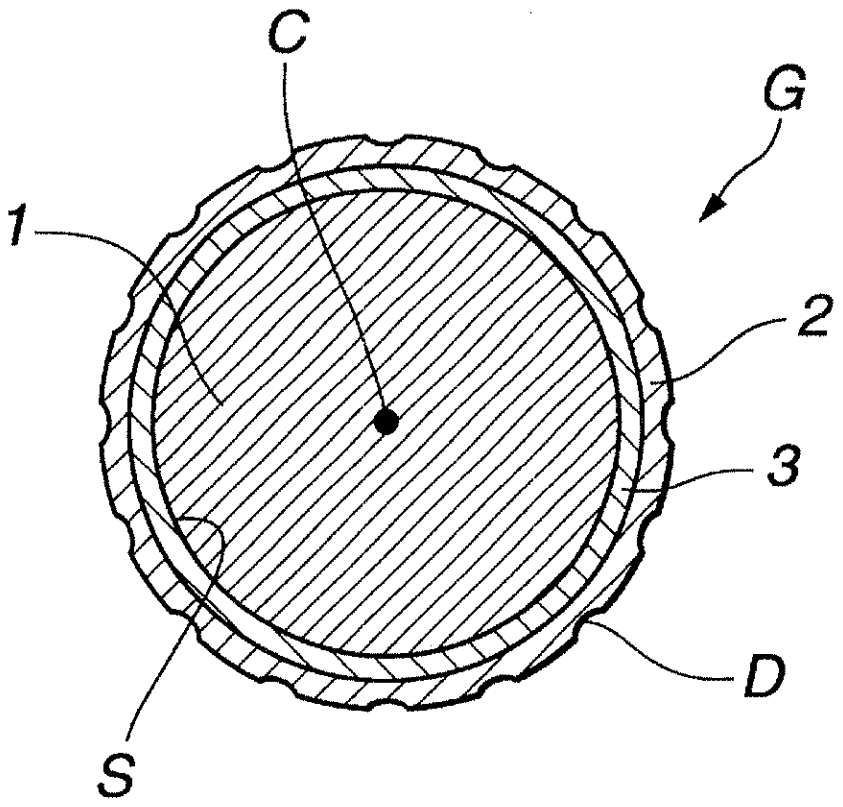


FIG.1



GOLF BALL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a golf ball having a multilayer construction of at least three layers which includes a core, an intermediate layer and a cover. More particularly, the invention relates to a golf ball which has good rebound characteristics and provides an excellent travel distance, controllability and "feel" upon impact with a golf club.

2. Prior Art

In recent years, solid golf balls, with their good flight performance, have consistently won greater general approval than conventional thread-wound golf balls.

Solid golf ball constructions include two-piece balls made of a solid, high-resilience, rubber core enclosed within a relatively thin resin cover, and multi-piece balls having a core, a cover, and also an intermediate layer therebetween whose properties differ somewhat from those of the cover.

As already noted, because of their good flight performance (i.e., long travel distance), solid golf balls of these types are widely favored by both amateur and professional golfers. Yet, there remains a desire among golfers for even better flight performance.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a golf ball having a multilayer construction of three or more layers that is endowed with improved distance without diminishing the controllability and feel that are so important to skilled golfers.

Accordingly, the invention provides a golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover. The intermediate layer is composed of a resin material which is harder than the cover. The elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

Preferably, the JIS-C hardness at the center of the core is 50 to 65, and the JIS-C hardness at the surface of the core is 70 to 90. The core typically undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

BRIEF DESCRIPTION OF THE DRAWING

The objects, features and advantages of the invention will become more apparent from the following detailed description, taken in conjunction with the accompanying diagram.

The only FIGURE, FIG. 1 is a sectional view showing a golf ball according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the golf ball G of the present invention has a construction composed of at least three layers, commonly known as a "multi-piece construction," which include a rubbery elastic core 1, a cover 2 that is generally made of a resin material and has a plurality of dimples D on the surface thereof, and one or more intermediate layer 3 between the core 1 and the cover 2, all situated in a concentric fashion. The illustrated embodiment has a single intermediate layer. The intermediate layer 3 is made of a resin material which is harder than the cover 2. The core 1 having a center C and a surface S at its radially outer extremity has a JIS-C hardness which gradually increases radially outward from the center C to the surface S. The core 1 is formed so as to have a specific hardness difference between the surface S and the center C.

The inventive golf ball includes a hard intermediate layer disposed between the core, which has an optimized hardness profile, and the cover which is softer than the intermediate layer. This construction provides the ball with an excellent "feel," holds down spin when the ball is struck with a driver, and increases the distance traveled, in part by creating a trajectory which does not describe a high arc when traveling into a headwind. At the same time, it increases the amount of spin on approach shots taken with a club having a large loft angle, thus imparting the excellent control desired in particular by professionals and other skilled golfers.

In the golf ball of the present invention, the core may be made from a known core material which is prepared by blending, for example, a base rubber, the metal salt of an unsaturated carboxylic acid, and an organic peroxide.

The base rubber is preferably polybutadiene. The use of 1,4-polybutadiene, and especially one having a cis structure of at least 40%, is recommended. In addition to the polybutadiene, the base rubber may also include other rubbers such as natural rubber, polyisoprene rubber and styrene-butadiene rubber, if necessary.

Examples of suitable metal salts of unsaturated carboxylic acids include zinc dimethacrylate and zinc diacrylate. Zinc diacrylate is especially preferred for achieving a high rebound energy. It is advantageous to include such unsaturated carboxylic acids in an amount of at least 15 parts by weight, and preferably at least 20 parts by weight, but not more than 50 parts by weight, and preferably not more than 45 parts by weight, per 100 parts by weight of the base rubber.

Examples of suitable organic peroxides include 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, dicumyl peroxide, di-(t-butylperoxy)-m-diisopropylbenzene and 2,5-dimethyl-2,5-di-t-butylperoxyhexane. It is advantageous to include such peroxides in an amount of at least 0.1 part by weight, and preferably at least 0.5 part by weight, but not more than 5 parts by weight, and preferably not more than 2 parts by weight, per 100 parts by weight of the base rubber.

To impart good rebound characteristics, it is advisable to include a suitable compounding ingredient such as a thiophenol, thionaphthol, halogenated thiophenol or metal salt thereof in the core material. Specific examples of such compounding ingredients that may be used include pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol. The zinc salt of pentachloro-thiophenol is especially preferred. Such a compounding ingredient is typically included in an amount of at least 0.4 part by weight, and preferably at least 0.6 part by weight, but not more than 2.0 parts by weight, and preferably not more than 1.2 parts by weight, per 100 parts by weight of the base rubber. Too much of this ingredient tends to lower the core hardness, which can adversely impact the feel of the ball when hit as well as its durability (cracking resistance), whereas too little may lower the rebound energy of the core, making it impossible for the ball to achieve a sufficient carry.

If necessary, the core material may include also various additives such as inorganic fillers and antioxidants. Illustrative examples of such additives include zinc oxide, barium sulfate and calcium carbonate.

The core may be fabricated from the above core material by using a conventional process to blend the various ingredients and mold the resulting mixture. For example, the constituent ingredients may be blended in a suitable apparatus such as a Banbury mixer or a kneader to form a "slug," which is then placed in a mold where it is vulcanized at a temperature of generally at least 150° C., and preferably at least 160° C., but generally not more than 190° C., and preferably not more than 180° C. The period of vulcanization is generally at least 8 minutes, and preferably at least 12 minutes, but generally not more than 20 minutes, and preferably not more than 16 minutes.

The weight and diameter of the core may be suitably adjusted according to such factors as the constituent materials and thickness of the intermediate layer and the cover, which are described subsequently. It is recommended that the core generally have a weight of at least 23 g, and preferably at least 30 g, but not more than 37 g, and preferably not more than 35 g. It is also recommended that the core generally have a diameter of at least 33 mm, and preferably at least 36 mm, but not more than 39 mm, and preferably not more than 38 mm.

It is critical for the core to have an optimized hardness profile in which the hardness gradually increases radially outward from the center toward the outside edge or surface of the core. That is, the core has a higher hardness at the surface than at the center.

The core center and surface must have a difference between their respective measured JIS-C hardnesses of at least 18, preferably at least 20, and most preferably at least 22 units. This difference in hardness within the core gives the ball a low spin when hit with a driver (number 1 wood), enabling it to travel well and thus attain a good total distance. Too small a difference in JIS-C hardness between the relatively soft center and the relatively hard surface of the core allows the ball to take on too much spin when hit with a driver, so that it does not travel well and has a short run after it lands on the ground. This makes it impossible to achieve the desired distance. It is recommended that the upper limit in the hardness difference be at most 30, preferably 27 or less, and most preferably 25 units or less.

Specifically, the core at the center typically has a JIS-C hardness of at least 50, and preferably at least 55, but not more than 65, and preferably not more than 62. The core at the surface typically has a JIS-C hardness of at least 70, and preferably at least 75, but not more than 90, and preferably not more than 85. Too low a JIS-C hardness at the core center may deaden the feel and fail to achieve the desired rebound energy, whereas a hardness that is too high may result in an excessively hard feel when the ball is hit. Similarly, too low a JIS-C hardness at the core surface may deaden the feel of the ball when hit, while too high a hardness may result in too hard a feel.

Preferably the core of the inventive golf ball has a deformation of at least 3.0 mm, and preferably at least 3.3 mm, but not more than 5.0 mm, and preferably not more than 4.5 mm, when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf). Too small a deformation may increase the spin when the ball is hit with a driver, preventing the desired travel from being achieved, and may also give the ball too hard a feel. On the other hand, too much deformation may deaden the feel and fail to achieve the necessary rebound energy.

Since the core has a hardness gradually increasing radially outward from the center to the surface thereof and an optimized difference in hardness between the center and the surface where the core is hardest, the inventive golf ball having the above-described core functions to suppress the generation of excessive spin when it is hit with a driver, effectively increasing the run after it lands on the ground, and thus travelling a longer total distance.

The intermediate layer **3** of the inventive golf ball is an essential layer which is situated between the core **1** and the cover **2** of the ball G, as shown in FIG. **1**, and is made of a resin material that is harder than the cover material. Even if the core and cover are within the scope of the present invention, a golf ball lacking the adequate intermediate layer prescribed by the present invention fails to attained the objects of the invention since it cannot adequately suppress spin when hit with a driver, making it impossible to achieve a longer travel distance, and gives a poor feel when hit.

The intermediate layer may be made using a known cover material, illustrative examples of which include an ionomer resin, either by itself or in admixture with a polyester, polyurethane, polyamide, polyolefin or polystyrene thermoplastic elastomer. The use of an ionomer resin by itself is especially preferred, although another thermoplastic resin may be used provided the resin material for the intermediate layer has a greater hardness than the cover. As with the cover material described below, pigments and various other additives may be included in the intermediate material.

The intermediate layer can be formed over the surface of the core using a known process, preferably an injection molding process. For example, once the core is placed within a mold, the intermediate layer material is injection molded over the core in a conventional manner.

The intermediate layer must have a greater hardness than the cover, which is described below. If the intermediate layer has a hardness which is the same as or lower than that of the cover, spin is not adequately suppressed when the ball is hit with a driver, in addition to which the ball has a lower rebound energy, preventing the anticipated total distance from being achieved. It is generally advantageous for the intermediate layer and the cover to have a Shore D hardness difference of at least 2, and preferably at least 5 units, but not more than 20, and preferably not more than 15 units.

It is recommended that the intermediate layer itself have a Shore D hardness of generally at least 50, and preferably at least 55, but not more than 67, and preferably not more than 65.

As already noted, the intermediate layer situated between the core and the cover in the golf ball of the invention has a greater hardness than the cover. The hardnesses of the intermediate layer and the core, when compared using the same hardness scale (i.e., JIS-C hardness or Shore D hardness), are preferably such that the intermediate layer has a greater hardness than the surface of the core. The JIS-C hardness difference between the intermediate layer and the core surface is preferably at least 2, and more preferably at least 6 units, but not more than 22, and more preferably not more than 18 units.

It is recommended that the intermediate layer have a thickness which is generally at least 0.5 mm, but not more than 3 mm, and especially not more than 2 mm. In cases where there are two or more intermediate layers, it is advisable to set the overall thickness of the intermediate layers within the above range.

If the golf ball has two or more intermediate layers situated between the core and the cover, the above-described

hardness relationship must be maintained between the cover and the outer intermediate layer which is in close contact with the cover.

The cover of the golf ball is formed of a material which is softer than the intermediate layer material. Examples of suitable cover materials include ionomer resins and polyurethane thermoplastic elastomers which are softer than the intermediate layer material. The use of an ionomer resin is especially preferred.

It is advantageous for the cover to have a Shore D hardness of generally at least 45, and especially at least 48, but not more than 60, and especially not more than 58. A hardness value that is too low may result in increased spin and an inability to achieve the required total distance. On the other hand, a hardness value that is too high may adversely impact the controllability of shots taken with an iron club having a large loft angle, and approach shots.

A conventional process may be used to form the cover. It is especially preferable to use an injection molding process in which a solid core over which an intermediate layer has been formed is placed within a mold, and the cover material is injection molded over the intermediate layer.

It is recommended that the cover generally have a thickness of at least 0.6 mm, and preferably at least 1.0 mm, but not more than 2.1 mm, and preferably not more than 1.8 mm. Too thin a cover may lower the durability of the ball, whereas a cover that is too thick may lower the ball's rebound energy.

Since the golf ball of the invention has an optimized balance in hardness among the various layers as described above, the ball is endowed with an excellent rebound energy, distance performance, feel, controllability and spin characteristics.

For competition play, the golf ball of the invention may be formed so as to have a diameter and weight which conform with the Rules of Golf. That is, the ball may have a diameter of not less than 42.67 mm and a weight of not greater than 45.93 g.

The inventive golf ball provides increased distance when hit with a driver. On approach shots, the ball has excellent spin characteristics to ensure control as desired. Moreover, it has a good feel on impact. This combination of qualities enables the ball to satisfy the high expectations of skilled golfers in particular.

EXAMPLES

Examples of the invention and comparative examples are given below by way of illustration, and are not intended to limit the invention.

Examples 1-3 and Comparative Examples 1-5

To ascertain the flight characteristics and feel of golf balls according to one embodiment of the invention, golf balls with different hardnesses at the center and surface of the core were produced in Examples 1, 2 and 3. A number of additional examples were carried out for the purpose of comparison. The golf balls produced in Comparative Example 1 had cores with a small or flat hardness profile. The balls produced in Comparative Example 2 had cores with a noticeable, yet gradual, hardness profile. The balls produced in Comparative Example 3 had a core with a distinct hardness profile, but had an intermediate layer that was softer than the cover. The balls produced in Comparative Examples 4 and 5 similarly had cores with distinct hardness profiles, but lacked an intermediate layer. Comparative tests were conducted on these various balls.

The balls were all given the same arrangement of dimples on the surface of the cover. Namely, each ball had a total of 432 dimples of three types formed on the cover in an icosahedral arrangement.

Tables 1 and 2 below show the characteristics of the cover and intermediate layer in the ball samples in each example. Table 3 gives the characteristics of the core in the same balls, and Table 4 presents the test results obtained for each type of ball.

TABLE 1

		Example			Comparative Example				
		1	2	3	1	2	3	4	5
Cover	Material	a	a	a	a	a	b	a	a
	Thickness (mm)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Hardness (Shore D)	55	55	55	55	55	65	55	55
Inter-mediate layer	Material	b	b	b	b	b	a	—	—
	Thickness (mm)	1.5	1.5	1.5	1.5	1.5	1.5	—	—
	Hardness (Shore D)	65	65	65	65	65	55	—	—

TABLE 2

Cover, intermediate layer		a	b
Composition (parts by weight)	Himilan AM7317 (Zn)[1]		50
	Himilan 1650 (Zn)[2]	50	
	Himilan AM7318 (Na)[3]		50
	Surlyn 8120 (Na)[4]	50	
	Titanium oxide	5	5
Hardness	Shore D hardness	55	65
	JIS-C hardness	80	94

[1]A zinc ionomer resin having an acid content of 18% made by DuPont-Mitsui Polychemicals Co., Ltd.
[2]A zinc ionomer resin made by DuPont-Mitsui Polychemicals Co., Ltd.
[3]A sodium ionomer resin having an acid content of 18% made by DuPont-Mitsui Polychemicals Co., Ltd.
[4]A sodium ionomer resin made by E. I. DuPont de Nemours and Co.

TABLE 3

			Example			Comparative Example				
			1	2	3	1	2	3	4	5
Core	Compo-sition (pbw)	1,4-cis-Polybutadiene	100	100	100	100	100	100	100	100
		Zinc diacrylate	41.0	38.0	35.0	28.0	27.8	38.0	32.1	28.4
		Peroxide (1)[1]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
		Peroxide (2)[2]	0.8	0.8	0.8	0.6	0.6	0.8	0.8	0.8
		Sulfur[3]	0.1	0.1	0.1	0	0	0.1	0.1	0.1
		Antioxidant[4]	0	0	0	0.2	0.2	0	0	0
		Barium sulfate	24.1	25.2	26.4	29.8	29.9	25.2	12.8	14.4
		Zinc oxide	5	5	5	5	5	5	5	5

TABLE 3-continued

			Example			Comparative Example				
			1	2	3	1	2	3	4	5
	Zinc salt of pentachlorothiophenol		1	1	1	0.2	0.2	1	1	1
Vulcanization conditions	Primary	Temperature (° C.)	175	175	175	140	155	175	175	175
		Time (min)	15	15	15	30	15	15	15	15
	Secondary	Temperature (° C.)	—	—	—	165	—	—	—	—
		Time (min)	—	—	—	15	—	—	—	—
Hardness	Surface (JIS-C hardness)		85	83	78	76	76	83	87	80
	Center (JIS-C hardness)		61	59	55	72	60	59	63	56
	JIS-C hardness difference		24	24	23	4	16	24	24	24
Deformation under loading (mm)[5)]			3.4	3.8	4.1	3.3	3.4	3.8	3.4	4.1

[1)]Dicumyl peroxide, produced by NOF Corporation under the trade name Percumyl D.
[2)]1,1-Bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, produced by NOF Corporation under the trade name Perhexa 3M-40.
[3)]Zinc white-containing sulfur, produced by Tsurumi Chemical Industry Co., Ltd.
[4)]Nocrack NS-6, produced by Ouchi Shinko Chemical Industrial Co., Ltd.
[5)]Deformation under loading from an initial load of 98 N to a final load of 1,275 N.

TABLE 4

		Example			Comparative Example				
		1	2	3	1	2	3	4	5
Flight[1)]	Carry (m)	233.0	232.2	231.1	233.2	232.1	232.5	231.8	229.5
	Total distance (m)	241.2	243.8	244.9	238.5	239.9	245.5	238.3	241.1
	Spin (rpm)	2805	2745	2700	2910	2855	2550	2952	2847
	Rating	good	good	good	poor	poor	good	poor	fair
Approach[2)]	Spin (rpm)	5833	5821	5811	5849	5830	4100	5870	5832
	Rating	good	good	good	good	good	poor	good	good
Feel[3)]	When hit with driver	good	good	good	good	good	good	good	poor
	When hit with putter	good	good	good	good	good	poor	good	good

[1)]Flight was rated as follows, based on distance measured when ball was hit at a head speed of 50 m/s by a driver mounted on a swing robot.
Good: Total distance at least 241 m
Fair: Total distance at least 241 m, but carry less than 230 m
Poor: Total distance 240 m or less.
[2)]Approach was rated as follows, based on spin rate measured when ball was hit at a head speed of 19 m/s by a sand wedge mounted on a swing robot.
Good: Good spin (at least 5,500 rpm)
Poor: Inadequate spin (less than 4,500 rpm)
[3)]Average sensory evaluations for five professional golfers:
Good: Feel was appropriate and good.
Poor: Feel was too hard or too soft.

As is apparent from the results in Table 4, the golf balls according to the invention all showed a good balance of distance, controllability on approach shots, and feel.

By contrast, the golf balls produced in the comparative examples each had drawbacks. In Comparative Examples 1 and 2, the hardness difference between the surface and center of the core was less than 18, resulting in much spin and a poor distance when the ball was hit with a driver. In Comparative Example 3, the cover was harder than the intermediate layer, and had an excessively high hardness. As a result, the amount of spin on approach shots was low and controllability was poor. In addition, the feel when hit with a putter was poor. The golf balls produced in Comparative Example 4 were two-piece balls which lacked between the cover and the core an intermediate layer of greater hardness than the cover. These balls had a lot of spin when hit with a driver, and thus a poor distance. In the golf balls produced in Comparative Example 5, the core hardness was lowered to reduce the high spin rate on impact with a driver in Comparative Example 4, but the resulting feel on impact with a driver was too soft.

Japanese Patent Application No. 2000-190640 is incorporated herein by reference.

Although some preferred embodiments have been described, many modifications and variations may be made thereto in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described without departing from the scope of the appended claims.

What is claimed is:

1. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

2. The golf ball of claim 1, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

3. The golf ball of claim 1, wherein said core undergoes a deformation of 3.0 to 5.0 mm when the load applied

thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

4. The golf ball of claim 1, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 22 to 30 units.

5. The golf ball of claim 1, wherein the intermediate layer has a Shore D hardness of 50 to 67.

6. The golf ball of claim 1, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

7. The golf ball of claim 1, wherein the cover has a Shore D hardness of 45 to 60.

8. The golf ball of claim 1, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

9. The golf ball of claim 1, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

10. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

11. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

12. The golf ball of claim 1, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

13. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

14. The golf ball of claim 13, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

15. The golf ball of claim 13, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 22 to 30 units.

16. The golf ball of claim 13, wherein the intermediate layer has a Shore D hardness of 50 to 67.

17. The golf ball of claim 12, wherein the JIS-C hardness difference between said intermediate layer and said core surface is 2 to 22 units.

18. The golf ball of claim 12, wherein the cover has a Shore D hardness of 45 to 60.

19. The golf ball of claim 12, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

20. The golf ball of claim 12, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

21. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

22. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentafluorothiophenol.

23. The golf ball of claim 13, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

24. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover having a Shore D hardness of 45 to 58 and has a greater hardness than the surface of the elastic core when compared using the same hardness scale, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 22 between the center and the surface.

25. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of thiophenol, thionaphthol, halogenated thiophenol and metal salt thereof.

26. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient selected from a group consisting of pentachlorothiophenol, pentafluorothiophenol, pentabromothiophenol, p-chlorothiophenol and the zinc salt of pentachlorothiophenol.

27. The golf ball of claim 24, wherein said elastic core is formed of rubber as the base material comprising an ingredient of zinc salt of pentachlorothiophenol added in an amount of 0.4 to 2.0 parts by weight, to per 100 parts by weight of the base rubber.

* * * * *

EXHIBIT 2

Sughrue
SUGHRUE MION ZINN MACPEAK & SEAS, PLLC

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Brian W. Hannon
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June 15, 2001

BOX PATENT APPLICATION
Commissioner for Patents
Washington, D.C. 20231

Re: Application of Hideo WATANABE
GOLF BALL
Assignee: BRIDGESTONE SPORTS CO., LTD.
Our Reference: Q64962

Dear Sir:

Attached hereto is the application identified above including 16 pages of the specification, including the claims and abstract, one (1) sheet of drawings (Figure 1), executed Assignment and PTO 1595 form, and executed Declaration and Power of Attorney. Also enclosed is the Information Disclosure Statement.

The Government filing fee is calculated as follows:

Total claims	3	- 20	=		x	$18.00	=	$.00
Independent claims	1	- 3	=		x	$80.00	=	$.00
Base Fee								$710.00
TOTAL FILING FEE								**$710.00**
Recordation of Assignment								$40.00
TOTAL FEE								**$750.00**

Checks for the statutory filing fee of $710.00 and Assignment recordation fee of $40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 and 1.17 and any petitions for extension of time under 37 C.F.R. § 1.136 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from June 26, 2000, based on Japanese Application No. 2000-190640. The priority document is enclosed herewith.

Respectfully submitted,
SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
Attorneys for Applicant

By: _____
Brian W. Hannon
Registration No. 32,778

TITLE OF THE INVENTION

Golf Ball

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a golf ball having a multilayer construction of at least three layers which includes a core, an intermediate layer and a cover. More particularly, the invention relates to a golf ball which has good rebound characteristics and provides an excellent travel distance, controllability and "feel" upon impact with a golf club.

Prior Art

In recent years, solid golf balls, with their good flight performance, have consistently won greater general approval than conventional thread-wound golf balls.

Solid golf ball constructions include two-piece balls made of a solid, high-resilience, rubber core enclosed within a relatively thin resin cover, and multi-piece balls having a core, a cover, and also an intermediate layer therebetween whose properties differ somewhat from those of the cover.

As already noted, because of their good flight performance (i.e., long travel distance), solid golf balls of these types are widely favored by both amateur and professional golfers. Yet, there remains a desire among golfers for even better flight performance.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a golf ball having a multilayer construction of three or more layers that is endowed with improved distance without diminishing the controllability and feel that are so important to skilled golfers.

CLAIMS:

1. A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

said intermediate layer is composed of a resin material which is harder than the cover, and

said elastic core has a hardness which gradually increases radially outward from the center to the surface thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

2. The golf ball of claim 1, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

3. The golf ball of claim 1, wherein said core undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

EXHIBIT 3

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Washington, D.C. 20231
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64952	6597

7590 05/17/2002

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER	
HUNTER, ALVIN A	

ART UNIT	PAPER NUMBER
3711	

DATE MAILED: 05/17/2002

#4

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/880,844	WATANABE, HIDEO
	Examiner	Art Unit
	Alvin A. Hunter	3711

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 June 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moriyama et al. (USPN 6336872) and OFFICIAL NOTICE.

Moriyama et al. discloses a golf ball having excellent flight performance and hitting feel (See Abstract). The golf ball comprises a center, intermediate layer, and an outer layer covering (See Abstract). The center comprises natural rubber and has a hardness of 65 to 85 JIS-C and a surface hardness higher than the center by no more than 10 and notes if the difference between the surface hardness and center are more than 10 then the rebound characteristics and shot feel are affected (See Column 2, lines 15 through 32; and Column 3, lines 15 through 39), in which is shown having a difference as high as15 in Comparative Example 2 in Table 7. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the surface higher than the center by any value, such as at least 18, in order to obtain the desired rebounding and feel characteristic for the golf ball through routine optimization. The intermediate layer is preferably made of an ionomer resin and has a hardness of 60 to 85 JIS-C (See Column 4, lines 49 through 56). The cover has a hardness 15 to 40 higher than the intermediate layer and notes that if the hardness

EXHIBIT 4

3711

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RKest 8/20/02 #5/a

In re application of

Hideo WATANABE

Docket No: Q64962

Appln. No.: 09/880,844

Group Art Unit: 3711

Confirmation No.: 6597

Examiner: Alvin A. HUNTER

Filed: June 15, 2001

For: GOLF BALL

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated May 17, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please add the following new claims 4-20:

4. (New) The golf ball of claim 1, wherein the difference in JIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

5. (New) The golf ball of claim 1, wherein the intermediate layer has a Shore D hardness of 50 to 67.

6. (New) The golf ball of claim 1, wherein the intermediate layer has a greater hardness than the surface of the elastic core when compared using the same hardness scale.

7. (New) The golf ball of claim 6, wherein the JIS-C hardness difference is 2 to 22 units.

8. (New) The golf ball of claim 1, wherein the cover has a Shore D hardness of 45 to 60.

9. (New) The golf ball of claim 1, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

10. (New) The golf ball of claim 1, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

11. (New) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover, wherein

said intermediate layer is composed of a resin material which is harder than the cover, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface, and undergoes a deformation of 3.0 to 5.0 mm when the load applied thereto is increased from an initial load of 98 N (10 kgf) to a final load of 1,275 N (130 kgf).

12. (New) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover, wherein

said intermediate layer is composed of a resin material which is harder than the cover, and

said elastic core has a hardness at the center and a hardness at the surface thereof which is greater than the hardness at the center thereof, and a difference in JIS-C hardness of at least 18 between the center and the surface.

13. (New) The golf ball of claim 12, wherein said core at the center has a JIS-C hardness of 50 to 65, and at the surface a JIS-C hardness of 70 to 90.

14. (New) The golf ball of claim 12, wherein the difference in DIS-C hardness between the center of the elastic core and the surface thereof is 18 to 30 units.

15. (New) The golf ball of claim 12, wherein the Intermediate .layer has a Shore D hardness of 50 to 67.

16. (New) The golf ball of claim 12, wherein the intermediate layer has a greater hardness than the surface of the elastic core when compared using the same JIS-C hardness scale.

17. (New) The golf ball of claim 16, wherein the JIS-C hardness difference is 2 to 22 units.

18. (New) The golf ball of claim 12, wherein the cover has a Shore D hardness of 45 to 60.

19. (New) The golf ball of claim 12, wherein the golf ball has two or more intermediate layers situated between the core and the cover, and said hardness relationship is maintained between the cover and the outer intermediate layer which is in close contact with the cover.

20. (New) The golf ball of claim 12, wherein the core is formed of rubber as a base and the cover is formed of materials including ionomer resins and polyurethane thermoplastic elastomers.

A1 (Cont.)

in order to obtain the desired rebounding and feel characteristic for the golf ball through routine optimization." Applicant submits that Moriyama teaches away from a difference of at least 18 when stating that the core difference must not be more than 10. One skilled in the art, based on this teaching, would not be motivated to increase the hardness difference to "at least 18," because Moriyama specifically teaches not to increase the difference above 10. Thus, the Examiner's unsupported conclusion is without merit.

Furthermore, the Comparative Example 2 shown in Table 7 does not satisfy the difference of "at least 18" in JIS-C hardness described above. In addition, according to the Comparative Example 2 of Table 7, the hardness of the intermediate layer is 62 and the hardness of the outer layer (cover) is 99 on JIS-C scale, which is the opposite relationship of hardness recited in claims 1 and 2.

Additionally, the Examiner acknowledges that the JIS-C hardness of the outer layer is higher than the hardness of the intermediate layer by 15 to 40. In other words, the intermediate layer of Moriyama is softer than the cover, which is the complete opposite relationship than that recited in claims 1 and 2. Once again, the Examiner attempts to cure the deficient teachings of Moriyama using only a broad conclusory statement that it would have been obvious to reverse the hardness relationship taught by Moriyama "in order to obtain the desired shot feel for the golf ball through routine optimization." However, broad conclusory statements regarding the teaching of references, alone, are not evidence. *Ecolochem, Inc. v. Southern Cal. Edison Co.*, 227 F.3d 1361, 1372 (Fed. Cir. 2000) (Emphasis added). Furthermore, the Examiner cannot simply ignore the teachings of the reference in order to meet the limitations of the claims. Such is impermissible hindsight. The mere fact that a reference can be modified does not make the

EXHIBIT 5

S.M.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/880,844	06/15/2001	Hideo Watanabe	Q64962	6597

7590 10/29/2002

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER	
HUNTER, ALVIN A	

ART UNIT	PAPER NUMBER
3711	

DATE MAILED: 10/29/2002 #6

Please find below and/or attached an Office communication concerning this application or proceeding.

13

Office Action Summary	Application No. 09/880,844	Applicant(s) WATANABE, HIDEO	
	Examiner Alvin A. Hunter	Art Unit 3711	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 August 2002* .

2a)☐ This action is FINAL. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☒ Claim(s) *14 and 15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§.119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a)☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *3* .
4)☐ Interview Summary (PTO-413) Paper No(s). _____ .
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other:

and Column 5, lines 1 through 9). The outer layer has a hardness 15 to 40 higher than the intermediate layer, preferably no less than 90 JIS-C or Shore D 60, and notes that if the hardness difference is smaller than 15 that the shot feel will be affected (See Column 5, lines 20 through 37). Moriyama et al. also notes that the golf ball may comprise dimples (See Column 5, lines 43 through 53). Moriyama et al. does not teach having an intermediate layer harder than the cover and having a hardness distribution of the core gradually increase from the center to the surface. Nakamura et al. discloses a two piece golf, in which improved feeling is obtained by providing a core with a hardness distribution with the hardness gradually decreasing from the core's surface to the core's center (See Background of the invention and the Detailed Description). The core has a Shore D hardness distribution and deformation that is equivalent to the JIS-C hardness and deformation ranges of that claimed by the applicant. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the surface higher than the center by at least 15 and a core deformation of 3 to mm, as taught by Nakamura et al., in order to obtain the desired feel characteristic for the golf ball through routine optimization. Farrally et al. teaches that the advantage of having a mantle layer harder than the cover if to give a golf ball increased resilience as well as hardness (See Alternate Multi-Layer Constructions on page 413). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have any difference in hardness of an intermediate layer harder than outer layer, as taught by Farrally et al., in order to increase the resilience and hardness of the golf ball.

EXHIBIT 6

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Hideo WATANABE

Docket No: Q64962

Appln. No.: 09/880,844

Group Art Unit: 3711

Confirmation No.: 6597

Examiner: Alvin A. HUNTER

Filed: June 15, 2001

For: GOLF BALL

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
Washington, D.C. 20231

Sir:

In response to the Office Action dated October 29, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please cancel claims 6, 11 and 16 without prejudice or disclaimer.

Please enter the following amended claims:

1. (Amended) A golf ball comprising a rubbery elastic core having a center and a radially outer surface, a cover having a plurality of dimples on the surface thereof, and at least one intermediate layer situated between the core and the cover; wherein

specification describes at least one reason why the elastic core has a difference in JIS-C hardness of at least 18 between the center and the surface:

> The difference in hardness within the core gives the ball a low spin when hit with a driver (number 1 wood), enabling it to travel well and thus attain a good total distance. Too small a difference in JIS-C hardness between the relatively soft center and the relatively hard surface of the core allows the ball to take on too much spin when hit with a driver, so that it does not travel well and has a short run after it lands on the ground. This makes it impossible to achieve the desired distance.

Specification page 5, lines 22-33.

Thus, since neither Nakamura nor Farrally cure the deficient teachings of Moriyama, Applicant submits that the references, either alone or in combination, do not disclose and suggest the difference of the claimed hardness and the effects thereof.

D. References fail to teach a core which gradually increases radially outward from the center to the surface thereof.

Applicant submits that the combination of these references fails to teach a core which "gradually increases radially outward from the center to the surface thereof." The Examiner acknowledges on page 3 of the office action that Moriyama fails to teach this feature, but then contends that Nakamura teaches this gradually increasing hardness of the core. However, Nakamura teaches that from 4 mm from the core's surface to 2 mm from the core 's surface, the hardness actually decreases. Nakamura col. 2:54-64; Abstract. Therefore, the core of Nakamura fails to gradually increase from the core center to the core surface. Accordingly, the cited references fail to teach or suggest this limitation.

EXHIBIT 7

THIS EXHIBIT HAS BEEN REDACTED IN ITS ENTIRETY

EXHIBIT 8

IN UNITED STATES DISTRICT COURT
DISTRICT OF DELAWARE

BRIDGESTONE SPORTS CO., LTD., and BRIDGESTONE GOLF, INC., *Plaintiffs,* *v.* **ACUSHNET COMPANY,** *Defendant.*	C.A. No. 05-132(JJF) DEMAND FOR JURY TRIAL

EXPERT REPORT OF LARRY C. CADORNIGA

Submitted on February 20, 2007

IX. GRADIENTS

[162] Dr. Koenig discusses the concept of core gradients starting at paragraph 302. Particularly, at paragraph 306, Dr. Koenig states his understanding that, "As a consequence, the curing will begin at the surface immediately, but will not begin at the core until the core reaches a sufficiently high temperature to decompose its crosslinking agent." I disagree that this is the only situation that could occur when curing a core material.

[163] While it is true that the surface of the core material closest to the mold will be directly exposed to longer curing times and to higher curing temperatures, particularly using the sulfur vulcanizing system, it is not necessarily true that there will also exist a gradient in hardness from the core to the surface.

[164] Based on my more than thirty years of hands-on rubber molding experience, it is my opinion that large variances in hardness readings or high degrees of differences in hardness readings within a rubber article such as golf ball cores is unwelcome and reflects poor quality of manufacture. Almost all rubber articles conform to requirements (which is the definition of "quality") based on hardness consistencies within specified tolerances.

[165] The discovery and invention of the gradient hardness in a golf ball core was found to be beneficial to enhance the performance qualities of golf balls as to: feel, spin, control on specific shots, resilience and durability.

[166] Dr. Koenig's statement that "for a golf ball, there will always be a gradient in hardness and other physical and mechanical properties from the core to the surface with the surface being higher" is not technically correct. This may be mostly true with respect to typical rubber articles but not necessarily true with solid golf ball cores:

a. For typical rubber articles, a certain degree of hardness gradient will exist, although the gradient may not be significant.

b. A golf ball core compound which has been formulated with crosslinkers using a peroxide curing system behaves differently. In the art of molding golf ball cores, the chemical reaction between the materials in the core formulation actually creates an exothermic reaction which can yield a higher temperature within the inside of the core. As the specified molding temperature reaches the center of the rubber core, the chemical reaction results in an increase in the temperature (higher than the designated mold temperature) and moves back to the surface and eventually reverses the vulcanizing (curing) phenomenon from "outside-to-inside" to "inside-to-outside." Based on my involvement in studies related to this curing phenomenon this often results in an internal hardness reading being higher than the hardness at the surface of the core, or results in hardness readings consistent throughout the core.

EXHIBIT 9

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

BRIDGESTONE SPORTS CO. LTD., and BRIDGESTONE GOLF, INC., Plaintiff,	:	
vs.	:	Civil Action No. 05-132
ACUSHNET COMPANY, Defendant.	:	

Washington, D.C.

Thursday, March 15, 2007

Videotape Deposition of:

JOHN CALABRIA,

the witness, was called for examination by counsel for the Defendant, pursuant to notice, commencing at 9:32 a.m., at the law offices of Howrey LLP, 1299 Pennsylvania Avenue, Northwest, Washington, D.C., before Dawn A. Jaques, Certified Shorthand Reporter and Notary Public in and for the District of Columbia, when were present on behalf of the respective parties:

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because if you have a low pressure, the conduction may be slower. If you have higher pressure, the conduction may be faster.

It also will depend on the size of the core.

Q Why does it depend on the size of the core?

A Smaller cores would conduct heat a little bit easier than larger cores.

Q Let me just go back to pressure because there's one other thing I want to understand about your opinion.

It's your understanding -- in order to make a golf ball, you have to supply enough pressure to the mold to keep it closed, correct?

A Yes, sir.

Q Okay. What I don't understand about -- strike that.

As long as you apply enough pressure to keep the mold closed, does the amount or the total amount of the pressure affect your opinion, provided there's at least enough pressure to keep

mold?

A It's the word I used.

Q Okay. We'll be communicating?

A Yes, sir.

Q Okay. Do you have an opinion about whether bumping the mold affects the core gradient of the core that's being molded?

A My opinion would be that if it's brief and closes again, then probably not.

Q Okay. All right. Now let me continue down your list.

You said that the geometry of the mold or the number of cavities could affect the core gradient; is that correct?

A I believe that's true, yes.

Q In what respect or what impact does the geometry of the mold have on the core gradients, in your opinion?

A Depends on how close the cavities are to each other, how many cavities are in a platen, how you're heating them, so it would help understand the spaces between the cavities, so how well are

you conducting heat to the cavities.

Also typically, depending on the size of the platen, some of the cavities on the edges might see less heat than cavities in the middle. And, again, you're dealing with an exothermic reaction, so it's -- potentially you might get more heat in the middle where you have a mass of -- metal and a mass of cores is concerned -- as compared to the outside.

Q Okay. Anything else on the geometry?

A No, I mentioned size.

Q Size. You did already tell me size --

A Yes.

Q -- and you told me the number of cavities.

A The number of cavities, arrangement on the platen, overall size of the platen, so how many cavities are on that platen, because you're going to get different properties if you have a 12-cavity mold versus a 120-cavity mold, for instance. I think that's possible.

Q How do you -- strike that.

In your opinion, why might the core gradient depend upon the number of cavities in the mold?

A Because of the way the heat is conducted --

Q Okay.

A -- to the core itself.

Q So depending upon how you apply the heat and the pressure, the number of cavities could affect the gradient depending upon how the heat's conducted across the mold --

A Correct.

Q -- is that what you're saying? I understand.

Just going back to the pressure for a second, have you personally investigated the effect of mold pressure on core gradients?

A I have not.

Q Okay. What is the basis for your opinions that pressure will or could affect the core gradient?

A Experience working in the industry.

BY MR. LAVELLE:

Q Okay. So in your opinion, if you -- if you know the material from which the core is made, the temperature at which the core is made, and the time that the core spends in the mold, knowing those three parameters, are they adequate for you to predict -- or for one skilled in the art to predict what the hardness profile is going to look like from the center to the surface of the core?

A I believe you'd have to include the other parameters we discussed, such as pressure, cavity size, location on the platen, how big is the platen. So there are a number of factors that need to be included.

Q Okay. So let me ask my question a different way that I think you can agree with it then.

If you know the ingredients in the core, the time that those ingredients spend in the mold, and the temperature at which the mold is heated, and that's all you know, that information is not adequate, in your opinion, for one skilled in the

art to predict what the hardness profile of the core is going to look like --

A Yes.

Q -- is that correct?

MR. CREMEN: Objection, vague.

THE WITNESS: I think they need more information.

MR. LAVELLE: All right. And now do you have that EP 043?

BY MR. LAVELLE:

Q Let me mark something that I think you've seen before.

A Do I put this aside for now?

Q Keep it nearby, but put it aside, yeah, exactly.

Sir, I'm going to mark as Exhibit 3 a European Patent Publication EP 633 043.

(Calabria Deposition Exhibit No. 3 was marked for identification.)

(A discussion was held off the record.)

BY MR. LAVELLE:

Q Sir, do you recognize Exhibit 3?

acrylate is generic. So I would want a little more information relative to that to understand.

And it goes back to what I was saying before, I believe, that these core chemistries can have varying effects on it; the process by which you do it have varying effects on it. And there are changes that -- and we all do it differently -- there are changes that occur within manufacturing that would affect the kind of gradients that you could see.

Consistency is key, I think. Doing it the same way every time, using the same materials every time would be important.

Q Okay. So I -- let me just stay where I was going because I really did want to focus on what one skilled in the art would understand, and your last answer focused on what you would want. So let me just -- I'm going to ask you sort of the same question again, and let me make sure your answer is accurately down.

A Okay.

Q What information, in addition to what's

described in EP 043, would one skilled in the art need to know, in your opinion, in order to predict what the hardness profile of the core is going to look like?

A I think one skilled in the art would know -- want to know, need to know the things I explained to you.

Q Okay. So that would be the pressure that we talked about already?

A Correct.

Q The molding geometry, including cavity sizes, number of cavities, how the heat is applied and other aspects of the geometry of the situation?

A Correct.

Q The details of how the core was mixed, including when different ingredients were added and how they were mixed and how the mixer was operated?

A Correct.

Q And is it also your testimony that you would need to know the brand name of the

ingredients that were used in the preparation of the core?

A Yes, that would be very helpful.

Q Would one skilled in the art need to know that information in order to predict the hardness profile of the core?

A My opinion is yes.

Q So it's your opinion that if I read a patent and it says to use cis-1,4-polybutadiene but it doesn't specify the brand, I don't have enough information to predict what the hardness profile of the core is going to look like?

A Correct.

Q Okay. And similarly, if a patent tells me that it's initiated by a peroxide but doesn't specify the brand and chemistry of the peroxide, I don't know enough to predict what the hardness profile is going to look like --

MR. CREMEN: Objection --

BY MR. LAVELLE:

Q -- is that your testimony?

MR. CREMEN: Sorry. Objection,

compound.

THE WITNESS: Yes.

BY MR. LAVELLE:

Q Okay. And let me cure his objection since he only objects when he's got a point.

If one skilled in the art reads a patent and the patent teaches you to use a peroxide but it doesn't tell you the brand of the peroxide, is it your opinion that one skilled in the art would not know enough to predict how the hardness profile of the core was going to look?

A Yes.

Q Okay. And peroxide comes in different grades and different chemistries and different chemical formulations from manufacturers, correct?

A It does.

Q All right. And can I call that the peroxide chemistry and we'll be communicating?

A Yes.

Q Okay.

A I'll agree to that.

Q All right. And if you don't agree, you

know, push back.

A I will.

Q I'll try and make it better.

Is it your opinion that if a patent teaches you to use a peroxide but it doesn't tell you enough about the chemistry of the commercial formulation of the peroxide, that you don't know enough to predict what the hardness profile of the core is going to be?

A That's fair.

Q Okay, fine. Do you need to know the fillers and inert ingredients that are in the core in order to predict what the hardness profile is going to be?

A I think they would have an impact on it, yes.

Q So do you need to know -- does one skilled in the art need to know those details in order to understand what the hardness profile is going to be?

A I'll say yes.

Q Okay. And you need to know the brand

name of the inert ingredients?

A Yes.

Q Okay. I don't know where you -- where would you put things like colorizers? You're aware that colorizers are sometimes used in a core?

A I am.

Q Okay. And do the colorizers, in your opinion, need to be specified in order to understand how the core is going to -- the hardness profile that's going to result in the core?

A I would say no.

Q Okay.

A They're a small part of it, a very small, minor part.

Q And I take it that it's true that your testimony about what you'd need to know to generate the -- strike that.

I take it that your testimony about one skilled in the art and what they would need to know to understand the hardness profile, that the

same factors that one skilled in the art would need to know to understand EP 043 would be true of any other patent that one skilled in the art reviewed?

A I think that's a fair statement.

Q Right. I mean, you're not keeping two sets of books for Bridgestone patents and for prior art patents, are you?

A No.

Q So your testimony with respect to this prior art EP 043 patent would apply equally to the Bridgestone patents?

A You're calling this a patent?

Q I'm sorry, the patent -- let me clear that up.

A This is an application.

Q You are right.

A Yes.

Q The document you're looking at is a patent specification they call it?

A Right.

Q And I think that it was later granted.

If you look at that first page of Exhibit 3 --

A Yes.

Q -- do you see -- the Europeans are kind enough to number these things. Do you see "(45) Mention of the grant of the patent"?

A There it is, yes.

Q And you see that that says it was -- the grant was noted in June of 1997?

A Yes.

Q Okay.

A But when I see EP 043, that says to me application.

Q You are absolutely correct. This is a --

A Just a clarification.

Q What you have in front of you, Exhibit 3, is a published application.

A Yes.

Q You're correct about that.

The only point I was saying is that your testimony about one skilled in the art would need

to know to understand the application EP 043 applies equally to the patents in suit in this case?

A Yes.

Q Okay, fine. Let me go back to -- and go -- we've just been talking about -- would you go to Paragraph 49 on page 12 of Exhibit 2?

A C-12?

Q No, I'm sorry. I'm just on page 12 in that front part of your report.

A A-12?

Q No, even before that.

A Oh, I'm sorry.

Q There's a front part --

A You're not even in Tab A?

Q Even before you get to Tab A, that's right.

A Yes, okay.

You're going to have to give me a page number.

Q Yeah, I'm sorry. Here. I'm on Paragraph 49 on page --

A Okay.

Q You say that "This mixing operation, including sequencing of materials, time parameters and temperature profiles, can affect the rate of curing of the core when heated and, therefore, the resultant hardness gradient."

Do you see that?

A I do.

Q What is the -- well, first of all, what is the basis for your understanding there?

A My experience in the industry.

Q Okay. Let me just see if we're communicating first.

It's my understanding that the core components are mixed at a temperature below the peroxide initiation temperature or the temperature where the peroxide starts to generate free radicals.

Is that your understanding?

A I think it's a fair description. It's the matter of how they're mixed.

Q Okay. But do you agree with the sort of

general principle that the mixing is typically done below the peroxide initiation temperature?

A You're trying not to kick off the reaction.

Q Exactly. Do you agree with that in general?

A I do.

Q Okay. Given that that's the case, I'm trying to understand why the manner of mixing matters to your opinion.

A Because you can't completely avoid it. The heat that's generated in the process will start to cure, which is why the material has to be used in a certain period of time.

Q Okay. It's -- my understanding is that good manufacturing processes would dictate that you use the core within a fairly short amount of time after you make it so that there isn't a lot of cross-linking before you get in the mold; is that your understanding?

A Well, you said --

MR. CREMEN: Objection, vague.

THE WITNESS: You said core. There's a different -- there's an intermediate step that you need to worry about.

BY MR. LAVELLE:

Q Okay. Go ahead.

A So when you --

Q You're punching out these blobs?

A The -- we call them plugs --

Q Plugs.

A -- or preforms --

Q Okay.

A -- or whatever you want to call them, and those are the ones that you have to use up in a certain period of time.

Q Okay.

A Otherwise, they will cure.

Q Okay, yeah, I guess what I'm trying to get at is if you mix the chemicals and punch out these plugs, these sort of pencil eraser-shaped objects, and mold them in accord with good manufacturing processes, will the manner in which you mix the ingredients matter in any material way

to the finish core and its hardness --

MR. CREMEN: Objection --

BY MR. LAVELLE:

Q -- profile?

MR. CREMEN: Objection, vague.

THE WITNESS: Yes, I think it will --

BY MR. LAVELLE:

Q It will.

A -- on the back end. Of what you're doing on the back end could have an effect on the front end.

Q Could you explain what you mean by that?

A It depends on the process you're using.

Q What are the "front end" and the "back end" would be a start.

A Okay. You can mix core material either on a unit called a Banbury or you can do it on a mill.

Q Okay.

A Okay? Do you want me to describe those?

Q I -- why don't you go --

A Do you understand?

Q I think I know what a Banbury mixer is --

A Okay.

Q -- and I can envision what a mill is.

A A Banbury is nothing but a big Mixmaster.

Q Mixmaster, right. It's a blender in your kitchen, right?

A Yeah, it's a blender.

A mill is what you use to make pasta --

Q Right.

A -- where you squeeze things out.

So you can do it one of two ways. You can put your materials in the Banbury and start loading in a certain sequence, and that sequence is important because if you put materials in at the wrong time, you will not get the curing or the properties.

And the same thing would apply to a mill. You need to put the material on the mill to be able to accept the other chemicals that you're adding to it.

Now, a mill and a Banbury are going to do different things to the core material in terms of the amount of time you're kneading, the amount of time you're mixing, the pressures you're applying, the temperatures you allow it to rise up to because some of these -- I think these machines are water-cooled to keep the temperature down to go back to your reference of preventing the peroxide from kicking off, okay?

So you're doing it either way. At some point, you have a sheet of material. That sheet of material now needs to be formed into your plug, and that's done through an extrusion process.

Q Okay.

A And that's adding heat again, so you have to be careful with that. There's no way to avoid it, and at some point you will have initiated the reaction.

So you extrude those plugs, you put them in a tray, you dust them so they don't stick together, and you have a limited amount of time to process them. And depending on where you catch

them in that cycle could determine what those properties are.

So to use your words, "good manufacturing practices," you try to be consistent as you move down the process.

Q Okay. And in that description, what's the -- what's the "front end" and what's the "back end"?

A Back end is the mixing and extruding. Front end is core molding.

Q Okay. Very good. And it's your opinion that if you follow what I'm calling good manufacturing practices, trying to minimize the amount of polymerization that occurs before you get the plug in the mold, will the order in which you mix still matter?

A Yes.

Q It will? Okay.

A Sorry.

Q He wants to object because it's asked and answered.

So if you wanted to know -- is it your

opinion that if you wanted to figure out if this EP 043 reference would have a core gradient within the 8 to 20 range of the '707 patent, you would need to know the details of the mixing operation as well?

A That would be helpful, yes.

Q Okay. Would you go up to Paragraph 47?

Do you see there's a discussion of some cores that Mr. Higuchi made?

A Yes.

Q Okay. And were you present at any of these experiments?

A I was not.

Q Okay. And the results were reported to you?

A Yes.

Q Okay. And in what fashion did you get the results of these?

A I think it was a spreadsheet.

Q Spreadsheet? And what data was on the spreadsheet, if you recall?

A Well, the formula was on there, the --

EXHIBIT 10

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

- - - - - - - - - - - - - - - - - - -x

BRIDGESTONE SPORTS CO., LTD., :

And BRIDGESTONE GOLF, INC., :

Plaintiffs, :

v. : C.A. NO. 05-132 (JJF)

ACUSHNET COMPANY, :

Defendant. :

- - - - - - - - - - - - - - - - - - -x

ACUSHNET COMPANY, :

Counterclaim Plaintiffs, :

v. : C.A. NO. 05-132 (JJF)

BRIDGESTONE SPORTS CO., LTD., :

And BRIDGESTONE GOLF, INC., :

Counterclaim Defendant. :

- - - - - - - - - - - - - - - - - - -x

HIGHLY CONFIDENTIAL

Videotaped Deposition of LARRY CADORNIGA

Washington, D.C.

Monday, March 12, 2007

9:00 A.M.

DIGITAL EVIDENCE GROUP

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gradient.

Q Yes, sir, but beyond what you argue here is it or is it not your opinion that you cannot assume what the hardness is at an internal point of the core relative to the surface of the core without testing that particular point.

A Yeah, I -- yeah, I would agree with that statement, that I cannot assume, unless I have already established that during my development system, then I would assume and be comfortable that's what I'm getting.

Q If you establish that; correct?

A If I establish that.

MR. DUBIANSKY: Okay. Excuse me, I'd like -- I'd like to mark the following document, please.

(Cadorniga Exhibit No. 9 was marked for identification.

BY MR. DUBIANSKY:

Q Mr. Cadorniga, I'm now going to show you an exhibit marked No. 9, and the title of this exhibit is expert report of John Calabria, and it's my understanding this report was submitted on the 20th of